

## Abstract for Space Mission Challenges for Information Technology Symposium 2003

### “High Capacity Ground Communications to Support Future Space Missions”

by Richard W. Markley

NASA/JPL expects that mission requirements for individual deep space missions will increase by at least a factor of ten every ten years; i.e., approximately 10 Mbps in 2010 and 100 Mbps in 2020. Because of the high costs of supporting an international antenna network such missions have significant impact on the Deep Space Network ground architecture. In addition, cooperation among distributed partners will continue, which increases data distribution costs to the various domestic and international operation centers and principal investigator teams.

Due to the high rates, users must distinguish between the data streams that are required immediately for spacecraft monitor and control purposes, and data streams that can be delivered more slowly for scientific processing and analysis. This division between "real time" and "non-real time" is a major architecture driver. The delivery requirements for scientific data streams can be divided into two more categories: (1) spacecraft data that must be transmitted within a certain number of hours for ground processing, and 2) data that which is simply required before the next downlink to avoid overflowing buffers at the station. The data rate on the latter may be considered simply "best efforts."

The traditional method for spacecraft data delivery has been over dedicated circuits. Circuits provide an easily predictable data rate, and support synchronous services such as operational voice and video. The architecture can be designed to provide appropriate capacity and availability. The costs of dedicated circuits, especially for international services, are fairly high, and when the cost of supporting future missions is estimated, other types of wide area network services must be considered.

The Internet Protocol (IP) supports all synchronous services needed today. However significant quality of service is required for voice because of its role in human communication. Thus, voice over IP (VOIP) is desirable to support this service over a network with significant control over quality of service.

Video broadcasts can also be supported over an IP network, and slight delays due to congestion are somewhat tolerable.

Real-time data requires a predictable time of delivery. Both dedicated circuits and their equivalent in router-based technology are included in the candidate ground communications architecture.

A candidate architecture has been evaluated that provides highly reliable services that support synchronous traffic and best effort services that are high rate but shared with other customers of the carrier to reduce costs (i.e., public Internet).

The architecture is expected to be very robust and will result in significant cost savings. Several components are undergoing prototype, piloting, or are operational today in the JPL Deep Space Mission System.

The research described in this paper was carried out at the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration.